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30th SPACE WING/VANDENBERG AIR FORCE BASE

LAUNCH SITE SAFETY ASSESSMENT

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LIST OF ABBREVIATIONS, ACRONYMS & DEFINITIONS

30 SW – 30th Space Wing
30 CES/CEV – 30th Space Wing Environmental Office
30 LG- 30th Logistics Group
30 MDG- 30th Medical Group
30 OG- 30th Operations Group
30 RANS/DO- 30 Range Squadron Director of Operations
30 RANS/DOUS- 30 Range Tasking/Scheduling
30 SW/SE - 30th Space Wing, Office of the Chief of Safety; see also Office of the Chief of Safety
30 SW/SEG - 30th Space Wing, Ground Safety
30 SW/SEGP - 30th Space Wing, Pad Safety
30 SW/SEO - 30th Space Wing, Mission Flight Control
30 SW/SEOS - 30th Space Wing, Space Transportation System Operations Support and Analysis
30 SW/SES – 30th Space Wing, Systems Safety
30 SW/SESE – 30th Space Wing, Systems Safety Engineering Support
30 SW/SESI – 30th Space Wing, Systems Safety Integration
30 SW/SEY – 30th Space Wing, Flight Analysis
30 SPTG - 30th Support Group
30 SW/XPR – 30th Space Wing, Plans & Requirements
ACC – Area Control Center
ACO – Air/Aeronautical Control Officer
ADESS – Analog Data Equipment Switching System
ADS – Acquisition Data System
ADSC – Acquisition Data Systems Controller
Aero - Aerospace
AF - Air Force
AFOSH – Air Force Occupational Safety and Health
AFI - Air Force Instruction
AFS – Air Force Station
AFSPC – Air Force Space Command
AFSPC/CE – Air Force Space Command Acquisition Civil Engineering
AFSPC/CEVR – Air Force Space Command Environmental Planning Division
AFSPC/DO – Air Force Space Command Director of Operations
AFSPC/DOSL – Air Force Space Command Commercial Space Lift Operations
AGC - Automatic Gain Control
ALD – Assistant Launch Director
ALTREV – Altitude reservation
ANT - Antigua Air Station

approval - Range Safety approval is the final approval necessary for data packages such as the Preliminary Flight Data Package, the Final Flight Data Package, the Missile System Prelaunch Safety Package, the Range Safety System Report, the Ground Operations Plan, and the Facility Safety Data Package. In addition, Range Safety approval is required for hazardous and safety critical procedures prior to the procedure being performed; however, Range Safety approval does not constitute final approval for hazardous and safety critical procedures since Range Users normally have additional approval requirements prior to the procedure being performed.

ARDES – Automatic Recorded Data Evaluation System

ARIA - Advanced Range Instrumentation Aircraft

ARG - Argentia

ARSR – Air Route Surveillance Radar

ARTCC – Air Route Traffic Control Center

ASC - Ascension Auxiliary Air Field

ASO – Astrotech Space Operations

ASOS – Automated Surface Observing System

AST - Associate Administrator for Commercial Space Transportation

ATOTS - Advanced Transportable Optical Tracking Systems

ATSS – Automated Train Surveillance System

CARF – Central Altitude Reservation Function

CATEX - Categorical Exclusion

CCAS - Cape Canaveral Air Station

CCC - Central Computer Complex

CCD - Charged Coupled Device

CCFF – Cape Canaveral Forecast Facility

CCPS – Central Control Processing System

CCRS - Central Command Remoting System

CCS – Command and Control System

CCT – Command Control Transmitter

CCTMS – Command Control Transmitter Mobile System

C/D – Countdown

CDR – Concept/Critical Design Review

CDS - Command Destruct System

CFR – Code of Federal Regulations

CIF - Central Integration Facility

CMC – Command Management Center

CMEV - Command Message Encoder Verifier

COLA – Collision Avoidance

Comm - Communications

commercial user - a non-federal government organization that provides launch operations services

Contr - Contracts

control authority - a single commercial user on-site director and/or manager, a full time government tenant director and/or commander, or United States Air Force squadron/detachment commander responsible for the implementation of launch complex safety requirements

CRA – clear text recording area

CRT – Cathode Ray Tube

CSC – Command System Controller

CSO – Complex Safety Officer

CTC – Command Transmitter Controller

DAC – Duty Air Controller

^{0} - degree, degrees

DASS – Doppler Acoustic Sounder System

dB – decibel. A unit used to express relative difference in power or intensity, usually between two acoustic or electric signals, equal to ten times the common logarithm of the ratio of the two levels. [deci- + bel.]

DEP – Directed Energy Plans

deviation - a designation used when a design noncompliance is known to exist prior to hardware production or an operational noncompliance is known to exist prior to beginning operations at CCAS and Vandenberg Air Force Base

DMI – Deployment Mapping Instrument

DMSP – Defense Meteorological Satellite Program

DNM – Data Network Manager

DOAMS - Distant Object Attitude Measurement System

DoD - Department of Defense

DoDD - Department of Defense Directive

DoT/FAA/AST – Department of Transportation /Federal Aviation Administration /Associate Administrator for Space Transportation

DPM – Data Processing Manager

$\mathbf{E_c}$ – casualty expectation

EA – Environmental Assessment

EELV - Evolved Expendable Launch Vehicle

EIAP - Environmental Impact Analysis Process

EIS - Environmental Impact Statement

ELV - Expendable Launch Vehicle

Eng - Engineering

EPC - Environmental Protection Committee

ER - Eastern Range

errant launch vehicle -a launch vehicle that, during flight, violates established flight safety criteria and/or operates erratically in a manner inconsistent with its intended flight performance. Continued flight of an errant launch vehicle may grossly deviate from planned flight, with the possibility of increasing public risk to unacceptable limits.

EWR – Eastern and Western Regulation

explosive quantity distance site plans - a formal plan for explosives facilities and areas required in accordance with AFM 91-201 and DoD 6055.9-STD detailing explosives quantity operating and storage limits and restrictions and resultant distance clearance requirements

explosives - all ammunition, demolition material, solid rocket motors, liquid propellants, pyrotechnics, and ordnance as defined in AFM 91-201 and DoD 6055.9-STD.

FAA/AST – Federal Aviation Administration/Associate Administrator for Space Transportation

failure - the inability of a system or system component to perform a required function within specified limits

FCA – Flight Caution Area or a mobile van specifically designed for and assigned the function of frequency control and analysis.

Flight Caution Area - a Hazardous Launch Area; the controlled surface area and airspace outside the Flight Hazard Area (FHA) where individual risk from a launch vehicle malfunction during the early phase of flight exceeds 1×10^{-6}. When activated, only personnel essential to the launch operation (mission-essential) with adequate breathing protection are permitted in this area; see also Flight Hazard Area, mission-essential personnel

FDP – Flight Data Package

FFPA – Final Flight Plan Approval

FHA – Flight Hazard Area

Flight Hazard Area - a Hazardous Launch Area; the controlled surface area and airspace about the launch pad and flight azimuth where individual risk from a malfunction during the early phase of flight exceeds 1×10^{-5}. Because the risk of serious injury or death from blast overpressure or debris is so significant, only mission-essential personnel in approved blast-hardened structures with adequate breathing protection are permitted in this area during launch.

flight termination action - the transmission of thrust termination and/or destruct commands to a launched launch vehicle and/or payload

Flt - Flight

FONSI - Finding of No Significant Impact

FOSM – Flight Operations Safety Manager

FPA – Flight Plan Approval

FSA – Flight Safety Analyst

FSDP – Facilities Safety Data Package

FSPO – Flight Safety Project Officer

FTS - Flight Termination Systems

FTS - Flight Termination System; includes the Radio Controlled Command Destruct System, the Automatic Destruct System, and associated subsystems

FTU - Flight Termination Unit

GHz - Gigahertz

GOES – Geostationary Orbiting Environmental Satellite

GOP – Ground Operations Plan

GSE – Ground Support Equipment

GSO – Guidance Systems Observer

GTO - Geotransfer Orbit

HAIR – High Accuracy Instrumentation Radar

hangfire - a condition that exists when the ignition signal is known to have been sent and reached an initiator but ignition of the propulsion system is not achieved

hazard, hazardous - equipment, systems, events, and situations with an existing or potential condition that may result in a mishap

HF - High Frequency

hold - a temporary delay in the countdown, test, or practice sequence for any reason

holdfire - an interruption of the ignition circuit of a launch vehicle, see “safety holds”

HQ - Headquarters

HPWT – High Performance Work Team

HYDROPAC – A special notice to mariners that defines the broad ocean hazard areas in the Pacific Ocean. It applies to boats and ships.

IFLOT - Intermediate Focal Length Optical Tracker

IGOR - Intercept Ground Optical Recorders

IIP – Instantaneous Impact Point

ILL - Impact Limit Line

imminent danger - any condition, operation, or situation that occurs on the Range where a danger exists that could reasonably be expected to cause death or serious physical harm, immediately or before the imminence of such danger can be eliminated through control procedures; these situations also include health hazards where it is reasonably expected that exposure to a toxic substance or other hazard will occur that will cause harm to such a degree as to shorten life or cause a substantial reduction in physical or mental efficiency even though the resulting harm may not manifest itself immediately

impact area - an area surrounding an approved impact point based on the launch vehicle and/or payload dispersion characteristics

impact limit line - a Hazardous Launch Area; the boundary within which trajectory constraints and FTSs are used to contain an errant launch vehicle and vehicle debris. Mission-essential and Wing-essential personnel are permitted within the ILLs; with Wing Commander approval, non-essential personnel may be permitted within this area. However, the collective risk will not exceed acceptable standards for non-essential personnel; see also mission-essential personnel, non-essential personnel

independent - not capable of being influenced by other systems

individual risk - the risk to a randomly exposed individual; the probability that the individual will be a casualty

INSRP – Interagency Nuclear Safety Review Panel

IPF – Integrated Processing Facility

IRIG – Inter-Range Instrumentation Group

ISA – Initial Support Agreement

ISP – Intended Support Plan(s)

ITL - Integrate-Transfer-Launch

ITT - Industries, Systems Divison Holds the Range Operations, Maintain, and Support Services Contract.

JDMTA - Jonathan Dickinson Missile Tracking Annex

JLRPG - Joint Long Range Proving Grounds

KMR – Kwajalein Missile Range

KSC - Kennedy Space Center

KTM - Kineto Tracking Mounts

KW – Kilowatt. A unit of power equal to 1,000 watts.

LA-24 – Large Aperture (24 inch) telescope located on Tranquillon Peak VAFB

LARA – Launch Area Risk Analysist

LASP – Launch Abort Subpanel

launch area - the facility, in this case, VAFB, where launch vehicles and payloads are launched; includes any supporting sites on the Western Range; also known as launch head

launch area safety - safety requirements involving risks limited to personnel and/or property on VAFB and involves multiple commercial users, government tenants, or United State Air Force squadron commanders

launch complex - a defined area that supports launch vehicle or payload operations or storage; includes launch pads and/or associated facilities

launch complex safety - safety requirements involving risk that is limited to personnel and/or property located within the well defined confines of a launch complex, facility, or group of facilities; for example, within the fence line; involves risk only to those personnel and/or property under the control of the control authority for the launch complex, facility, or group of facilities

launch head - see launch area

launch vehicle - a vehicle that carries and/or delivers a payload to a desired location; this is a generic term that applies to all vehicles that may be launched from the Western Range, including but not limited to airplanes; all types of space launch vehicles, manned space vehicles, missiles, and rockets and their stages; probes; aerostats and balloons; drones; remotely piloted vehicles; projectiles, torpedoes and air-dropped bodies

LBS - Launch base Support

LCC – Launch Commit Criteria

LD – Launch Director

LDZ – Launch Danger Zone

lead time - the time between the beginning of a process or project and the appearance of its results

LF – Launch Facility

LLPS – Lightning Location and Protection System

LOCC – Launch Operations Control Center

Log - Logistics

LONOTE – Local Notice to Mariners

LRR – Launch Readiness Review

LWO – Launch Weather Officer

MARSSS - Meteorological and Range Safety Support System

MAX-Q – Maximum Dynamic Pressure

MC – ROMSSC Mission Controller

MCS – Mission Control Supervisor

MDPS – Metric Data Processing System

Med – Medical or Medicine

MERCAST – merchant ship broadcasts

MFCC – Missile Flight Control Center

MFTGS – Missile Flight Termination Ground System

MIC - meets intent certification; a noncompliance designation used to indicate that an equivalent level of safety is maintained despite not meeting the exact requirements stated in this Regulation

MIGOR - Mobile Intercept Ground Optical Recorders

MIPIR – Missile Precision Instrumentation Radar

misfire - a condition that exists when it is known that the ignition signal has been sent but did not reach an initiator and ignition of the propulsion system was not achieved

mission-essential personnel - those persons necessary to successfully and safely complete a hazardous or launch operation and whose absence would jeopardize the completion of the operation; includes persons required to perform emergency actions according to authorized directives, persons specifically authorized by the Wing Commander to perform scheduled activities, and person in training; the number of mission-essential personnel allowed within Safety Clearance Zones or Hazardous Launch Areas is determined by the Wing Commander and the Range User with Range Safety concurrence

Mission Rules - a document of agreements between the Range User and Range Director specifying, in detail, those requirements and procedures not covered by this document

MFC – Mission Flight Control

MFCO - Missile Flight Control Officer

MFCO - Mission Flight Control Officer - a United States Air Force Officer or civilian who monitors the performance of launch vehicles in flight and initiates flight termination action when required; the direct representative of the Range Commander during the prelaunch countdown and during launch vehicle powered flight

MOTR – Multiple Object Tracking Radar

MOTS - Mobile Optical Tracking System

Msn - Mission

MSPSP – Missile System Prelaunch Safety Package

MSS – Meteorological Sounding System

MST – Mobile Service Tower

MSU - Message Storage Unit

MTDES – Magnetic Tape Dub and Evaluation System

MTE – Minimum Time to Endanger

MTI – Moving Target Indication

NASA - National Aeronautics and Space Administration

NASA KSC VLS - National Aeronautics and Space Administration, Kennedy Space Center, Vandenberg Launch Site

NASCOM - NASA Communications Network

NAWC – Naval Air Warfare Center

NEPA - National Environmental Policy Act

NEXRAD – WSR-88D Doppler Radar

NIMA – National Imagery and Mapping Agency (part of Coast Guard Marine Navigation Department)

nominal vehicle - a properly performing launch vehicle whose instantaneous impact point (IIP) does not deviate from the intended IIP locus

noncompliance - a noticeable or marked departure from Regulation standards or procedures; includes deviations, meets intent certifications, and waivers

non-essential personnel - those persons not deemed mission-essential or Wing-essential; includes the general public, visitors, the media, and any persons who can be excluded from Safety Clearance Zones with no effect on the operation or parallel operations

NOAA – National Oceanic and Atmospheric Association

NORAD – North America Defense Command

NOSC – Naval Ocean Systems Center

NOTAM – Notices to Airmen

NOTMAR – Notices to Mariners

NVAFB – North Vandenberg Air Force Base

OCC – Operations Control Center

OD - Operations Directive

Office of the Chief of Safety - the Range office headed by the Chief of Safety; this office ensures that the Range Safety Program meets Range and Range User needs and does not impose undue or overly restrictive requirements on a program

OPR - Office of Primary Responsibility

Ops - Operations

OpsSup – Operations Supplement to the RSOR for a particular test. OpsSup is prepared by Range Safety

OR - Operations Requirements

orbital injection (insertion) - the sequence of events in time and space, whereby a vehicle achieves a combination of velocity and position such that without additional thrust at least one orbit of the earth will be made

OSM – Operations Security Manager

OSS – Ocean System Surveillance

OST – Operations Safety Technician

P_i – Impact Probability

PAFB - Patrick Air Force Base

payload - the object(s) within a payload fairing carried or delivered by a launch vehicle to a desired location or orbit; a generic term that applies to all payloads that may be delivered to or from the Western Range; includes but is not limited to satellites, other spacecraft, experimental packages, bomb loads, warheads, reentry vehicles, dummy loads, cargo, and any motors attached to them in the payload fairing

PCC - Photo Control Console

PCM - Pulse Code Modulation

PDR – Preliminary Design Review

PFPA – Preliminary Flight Plan Approval

PI - Program Introduction

PL - public law

PLO – Payload Operator

PMTC – Pacific Missile Test Center

positive control - the continuous capability to ensure acceptable risk to the public is not exceeded throughout each phase of powered flight or until orbital insertion

PPF – Payload Processing Facility

PRD - Program Requirements Document

program - the coordinated group of tasks associated with the concept, design, manufacture, preparation, checkout, and launch of a launch vehicle and/or payload to or from, or otherwise supported by the Western Range and the associated ground support equipment and facilities

PSC – Program Support Concept

PSM – Program Support Manager

PSP - Program Support Plan

public safety - safety involving risks to the general public of the United States or foreign countries and/or their property

RADOT -

Range - in this document, Range refers to the Western Range at VAFB, KMR, & PMTC.

Range Commander - Commander of the Western Range in accordance with DoDD 3200.11; sometimes called Range Director, when interfacing with commercial Range Users.

NOTE: Currently, the 45 SW Commander is also the Range Commander and Range Director

Range Safety Launch Commit Criteria - hazardous or safety critical parameters, including, but not limited to, those associated with the launch vehicle, payload, ground support equipment, Range Safety System, hazardous area clearance requirements, and meteorological conditions that must be within defined limits to ensure that public, launch area, and launch complex safety can be maintained during a launch operation

Range Safety Program - a program implemented to ensure that launch and flight of launch vehicles and payloads present no greater risk to the general public than that imposed by the overflight of conventional aircraft; such a program also includes launch complex and launch area safety and protection of national resources

Range Safety System - the system consisting of the airborne and ground flight termination systems, airborne and ground tracking system, and the airborne and ground telemetry data transmission systems

Range Users - clients of the Western Range, such as the Department of Defense, non-Department of Defense US government agencies, civilian commercial companies, and foreign government agencies that use Western Range facilities and test equipment; conduct prelaunch, launch, and impact operations; or require on-orbit support.

RAPCON – Radar Approach and Control

RASCAD - Range Safety Control and Display

RCC – Range Control Center

RCO – Range Control Officer

RF - Radio Frequency

risk - a measure that takes into consideration both the probability of occurrence and the consequence of a hazard to a population or installation. Risk is measured in the same units as the consequence such as number of injuries, fatalities, or dollar loss. For Range Safety, risk is expressed as casualty expectation or shown in a risk profile; see also collective risk and individual risk.

risk analysis - a study of potential risk

ROC – Range Operations Commander

ROCC - Range Operations Control Center

ROMSSC – Range Operation, Maintenance, and Service Support Contractor

ROOTS – Remotely Operated Optical Tracking System

ROS – Representative Observation System

ROTI - Recording Optical Tracking Instrument/

RROC – ROMSSC Radar and Optics Controller

RSA - Range Standardization and Automation

RSDS - Range Safety Display System

RSLP - Rocket Systems Launch Program

RSOR - Range Safety Operating Requirements

RTDC- Real Time Data Controller

RTS - Range Tracking System

RUSSDPA – Range User Systems Safety Data Package Approval

SAB – Shuttle Assembly Building

Safety Clearance Zones - restricted areas designated for day-to-day prelaunch processing and launch operations to protect the public, launch area, and launch complex personnel; these zones are established for each launch vehicle and payload at specific processing facilities, including launch complexes.

safety holds - the holdfire capability, emergency voice procedures, or light indication system of each launch system used to prevent launches in the event of loss of Range Safety critical systems or violations of mandatory Range Safety launch commit criteria

SAF/SX – The Office of the Assistant Secretary of the Air Force (Space)

SAF/MII – Deputy Assistant Secretary of the Air Force/Installations

SC - Statement of Capability
SCO – Surveillance Control Officer
SDI – Strategic Defense Initiative
SDR – System Design Review
Sec - Security
SELV - Small Expendable Launch Vehicle
SGLS – Space Ground Link System
SHF – Super High Frequency
SIF – Selective Identification Feature
SLBM - Sea Launched Ballistic Missiles
SLC - Space launch Complex
SLF - Shuttle Landing Facility
SLS – Space Launch Squadron
SMAB - Solid Motor Assembly Building
SMARF - Solid Motor Assembly and Readiness Facility
SMC - Space & Missile Systems Center
SMC R&D - Space & Missile Systems Center Research and Development
SMFCO – Senior Mission Flight Control Officer
SMILS - Sonar Buoy Missile Locator Impact System
space safety professional - a safety professional who has been trained and formally certified to meet the criteria outlined in the Launch Complex Safety Training and Certification Program Document
SOI – Space Object Identification
Sp – Space
SP – Southern Pacific railroad
SPARC - Single Point Acquisition and Radar Control
SPF - Spaceport Florida Authority
SPS – Security Police Squadron
Spt - Support
SPTC – Southern Pacific Transportation Company
Sq – Squadron
SRR – System Requirements Review
SSRO – Surface Search Radar Operator
STS - Space Transportation System
STS/MOL - Space Transportation System/Manned Orbital Laboratory
Stan/Eval – Standardization/Evaluation
SVAFB – South Vandenberg Air Force Base
Svcs - Services
TAER – Telemetry Analog Equipment Room
TASSE – TAER Automated Scout Support Equipment
TBD – to be determined

TIM - Technical Interchange Meeting

TMC – ROMSSC Telemetry Controller

TMVS – Telemetry Validation System

TO – Training Officer

TOCC – Test Operations Control Center

TRAE – time, range, azimuth, and elevation

Trans - Transportation

transponder - the portion of the airborne Range tracking system that receives and decodes interrogations and generates replies to the interrogations. The transponder permits the ground instrumentation radar to furnish significantly greater precision and accuracy data at much greater distances and prevents mistracking of powered vehicles due to interference of exhaust plumes or spent stages

TSO – Telemetry Systems Officer/Observer

TTV – Transponder Test Van

UCS - Universal Camera Sites

UDS - Universal Documentation System

US - United States

USAF – United States Air Force

USAKA – US Army Kwajalein Atoll

USCG – United States Coast Guard

UHF - Ultra High Frequency

VAFB - Vandenberg Air Force Base

VDL – Voice Direct Lines

VHF - Very High Frequency

VIB - Vertical Integration Building

VP – Vertical Plane

VPS – Vehicle Peculiar Supplement

VRP - Video Remote Patch

VTRS – Vandenberg Telemetry Receiving Site

VWSS – Vertical Wire Skyscreen

waiver - a designation used when, through an error in the manufacturing process or for other reasons, a hardware noncompliance is discovered after hardware production, or an operational noncompliance is discovered after operations have begun at the Western Range

WCSC – Western Commercial Space Center

WCOOA – West Coast Offshore Operating Area

WINDS – Weather Information Network Display System

Wing Commander - see Range Commander

WOC – Weather Operations Center

WOPR – Wing Officer with Primary Responsibility

WR - Western Range

WRCC – Western Range Control Center

WRR – Western Range Regulation
WSWG – Wing Support Working Group

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SECTION 1.0

WESTERN RANGE

RANGE CAPABILITIES

1.1 GENERAL INFORMATION

1.1.1 Local Area and Local Population Information

Vandenberg Air Force Base (VAFB) is located on California's central coast approximately halfway between Los Angeles and San Francisco, 55 miles northwest of Santa Barbara. Vandenberg's unique location provides 35 miles of Pacific Ocean shoreline, over 98,000 acres of varied land terrain, and restricted airspace for aeronautical testing.

The portion of VAFB coastline north of Point Arguello faces west and much of the coastline south of Point Arguello has a southern exposure (see Figure 1-1). This unique geography permits potential launch azimuths from 140 degrees clockwise to 315 degrees, enabling over-ocean ballistic and polar space launches. VAFB is the only location in the continental United States permitting polar orbit spacecraft launches without over-flying any land mass. Table 1-1 shows the populated areas surrounding VAFB. These population centers consist of small cities and smaller villages at the tabulated distances from the nearest active launch pad. These populated areas may figure into any hazard calculations performed for a Commercial Launch Operation.

Table 1 - 1 Vandenberg AFB Local Populations

City	Population	Closest Space Launch Complex		
		SLC	Direction	Distance (mi)
Santa Maria	~69,000	SLC-2	NE	~13
Lompoc	~41,000	SLC-3	E	~6
Vandenberg Village	~6,000	SLC-3	NE	~7.5
Mission Hills	~3,000	SLC-3	NE	~8.5
Orcutt	~4,000	SLC-2	NE	~11
Lompoc Correctional Facility	~700	SLC-3	NE	~5
Casmalia	~200	SLC-2	NE	~6

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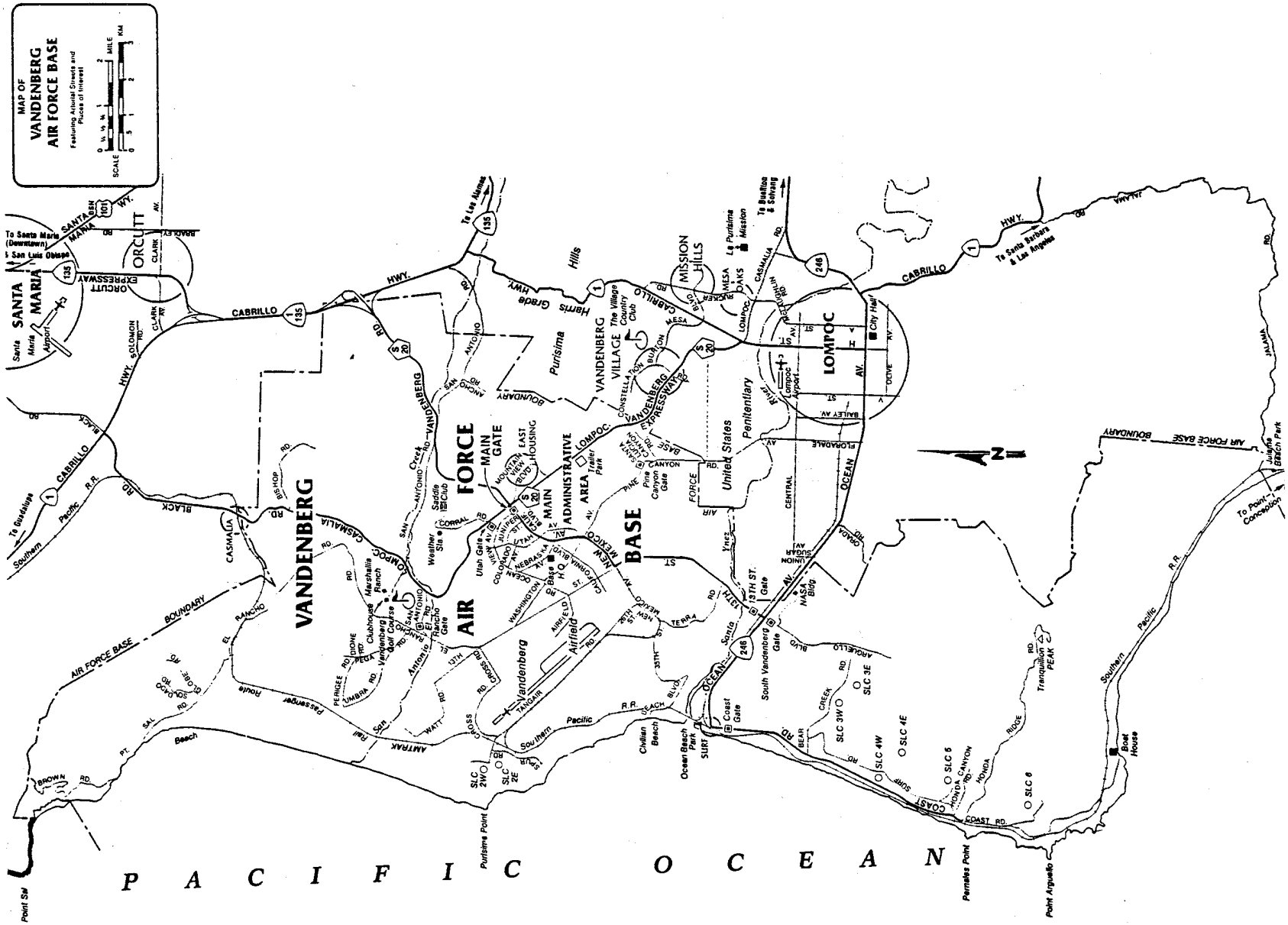

Figure 1 - 1: Vandenberg Air Force Base

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1.1.2 Western Range History/General Capabilities

In the early 1940's and 50's, an Army tank and artillery training area called Camp Cooke saw active service during World War II and the Korean War. It was also used for a Prisoner of War camp for German and Italian captives during World War II.

Between 1957 and 1965, the Air Force acquired Camp Cooke, the Navy's Point Arguello Launch Complex, and Sudden Ranch to make up today's base, the third largest Air Force base in the continental United States. In 1958, the name was changed to Vandenberg Air Force Base to honor the late General Hoyt S. Vandenberg, the second USAF Chief of Staff.

Headquartered at VAFB, the 30th Space Wing (30 SW) conducts space and missile launch operations and manages the Western Range. Generally, the launch facilities on North VAFB support ballistic missile launches into broad ocean areas and the Kwajalein Missile Range, while the space launch complexes support southerly over-ocean polar space launches. 30 SW instrumentation sites are located along the Pacific coast at Pillar Point AFS, Anderson Peak, VAFB, Santa Ynez Peak, and on the Hawaiian islands. In conjunction with other ranges, principally the Naval Air Warfare Center Weapons Division, Point Mugu, and the Army Kwajalein Missile Range, the WR provides continuous and complimentary instrumentation coverage over a broad portion of the Pacific Ocean. The West Coast Offshore Operating Area (WCOOA), which extends along the Pacific coast from Mexico as far north as the Canadian border, provides an aeronautical and guided-missile test corridor. The B-1, F-15, Navy Sea Launched Cruise Missile and Air Force Air Launched Cruise Missile have been tested in this area.

1.1.3 Western Range Organization

As shown in Figure 1-2, the 14th Air Force falls directly under the USAF Space Command. The Commander of the USAF Space Command reports directly to the Secretary of the Air Force. The 14th Air Force Commander, located at Vandenberg AFB, California, is responsible for operations at the 30th Space Wing (SW) at Vandenberg Air Force Base (VAFB), California; the 45th Space Wing operating both Patrick Air Force Base, (PAFB) and Cape Canaveral Air Station, (CCAS) in Florida; the 21st Space Wing at Peterson AFB, Colorado; and the 50th Space Wing at Schriever Air Base, Colorado.

The Commander 30th Space Wing is directly responsible for operations of the Western Range as follows:

- Final authority and responsibility for safety. (The Commander or a designated representative is responsible for carrying out the Range Safety Program described in EWR 127-1, Range Safety Requirements.);

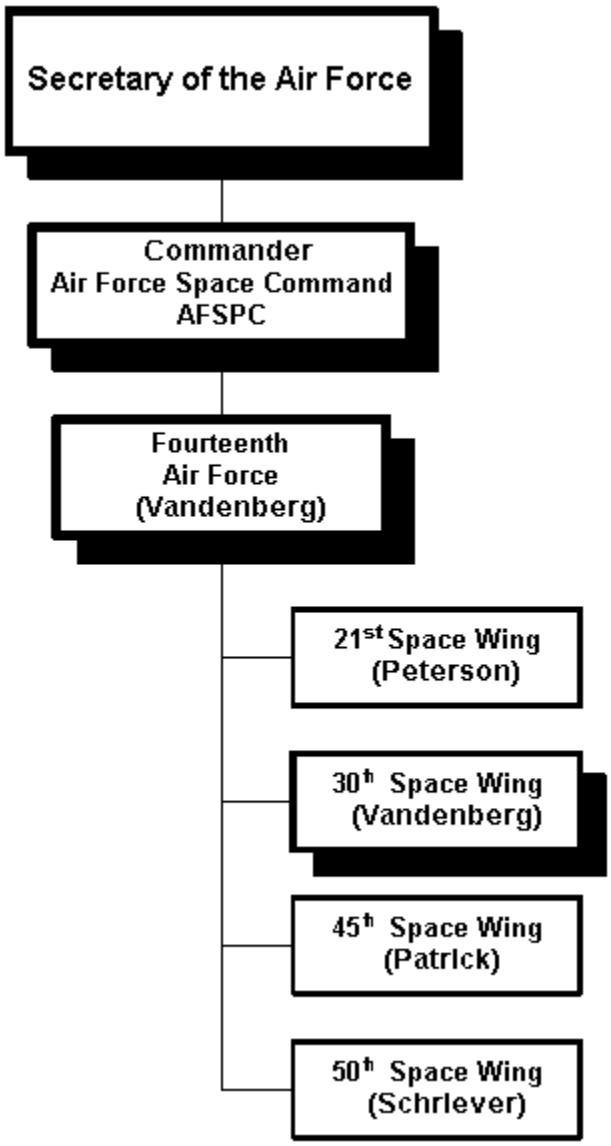


Figure 1 - 2: Fourteenth Air Force Organization

- Implements/handles non-compliance issues, and/or provides disposition of them with respect to the requirements of EWR 127-1 as they apply to range user programs;

- Where feasible, coordinates all actions between the Ranges (ER and WR) to ensure that consistent and standard Range Safety requirements and approvals are levied on all range users (EWR 127-1, Range Safety Requirements).

The 30th Space Wing Safety Office (30 SW/SE) is on the Wing Staff (see Figure 1-3). Its overall responsibility is to:

- Establish, direct, and manage the WR Commander's overall safety program in flying, nuclear, explosive, missile, ground/industrial, and system safety disciplines;
- Establish and direct the space vehicle and ballistic missile flight safety program;
- Ensure all agencies comply with the safety programs;
- Provide safety engineering, program management, and technical advice/ assistance to range users and to the Administrative Contracting Officer in evaluating contracting operations;
- Assist the Commander of the Western Range in preparation of the Range Safety portion of Program Support Plans, Operations Directives, and Range contracts;
- Provide technical contract management for the safety and ordnance portion of the Launch Base Support (LBS) and Range Operation, Maintenance, and Service Support Contractor (ROMSSC) contracts.

These functions are delegated to, and accomplished by, the 30 SW/SE Sections as detailed in Section 2.

1.1.4 Western Range

The Western Range embraces a large and versatile geographic area extending from the West Coast of the United States to 90 degrees East longitude in the Indian Ocean (see Figure 1-4). It has open ocean to the west and south.

Uprange and downrange support is provided by an extensive array of facilities including checkout and assembly facilities for launch vehicle and payload processing; and radar, telemetry, and optical sensors located at VAFB, Pillar Point AFS, Anderson Peak, and Santa Ynez Peak. These sensors can be augmented by similar sensors of the Naval Air Warfare Center (NAWC) located southeast of VAFB. To provide telemetry coverage farther south, or beyond the range of land-based sensors, the Advanced Range Instrumentation Aircraft (ARIA) of the

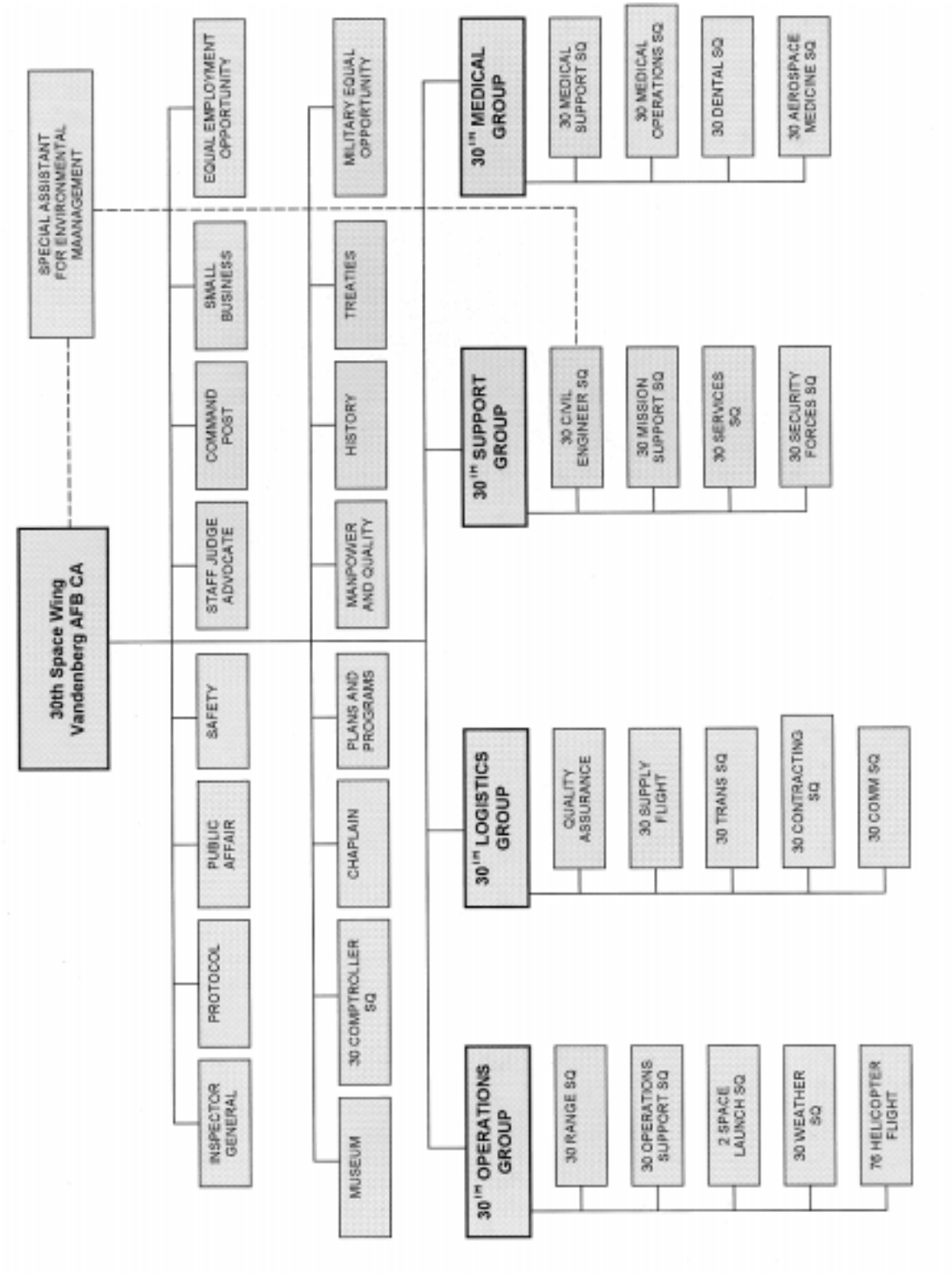
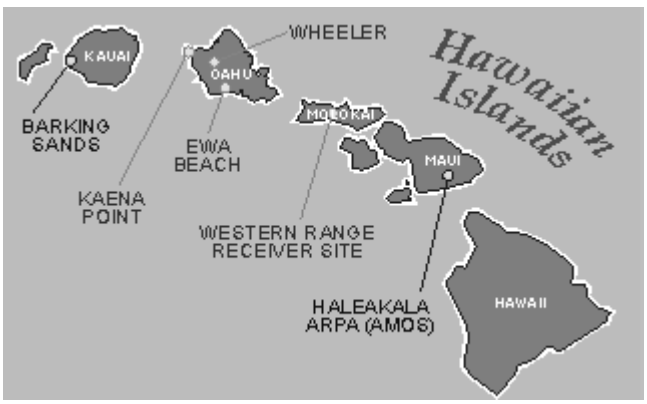


Figure 1 - 3: 30th Space Wing Organization



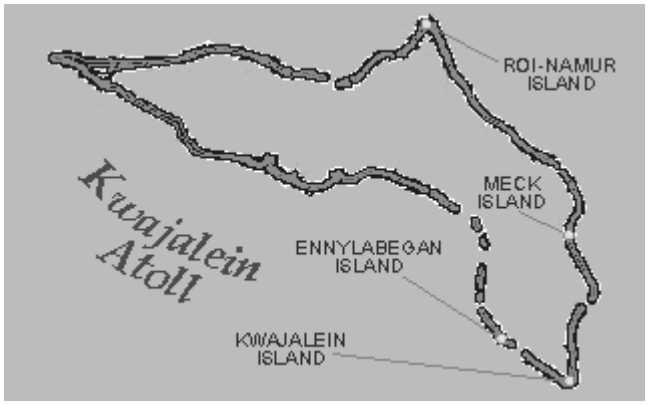


Figure 1 - 4: Western Range

452 Flight Test Squadron, Edwards AFB, CA, or Navy P-3's from the Naval Air Warfare Center (NAWC) at Point Mugu, CA may be used. Midrange support for ballistic tests is provided by sensors located in Hawaii. The 30 SW maintains radar and other data collection facilities on Molokai, and Oahu. Reentry support of ballistic launches is provided by mobile and fixed sensors at US Army Kwajalein Atoll (USAKA).

The 30 SW Range Operations Control Center at VAFB is the central telemetry and metric data processing facility. The Control Center is linked to launch complexes, assembly and checkout facilities, and data acquisition sites via landlines and microwave systems. In addition, the Control Center is linked to other DoD and NASA facilities for real-time transmission of data, voice, and message communications.

30 SW data handling capabilities provide a complete spectrum of services that range from collection and distribution to postflight analysis.

1.1.5 The Air Force Commercial Program

The Office of the Deputy Assistant Secretary of the Air Force (SAF/SX) (Space Plans and Policies) leads development of Air Force policy for support of commercial space activities. Air Force Space Command (AFSPC) Commercial Spacelift Operations (within AFSPC/DOSL) has management responsibility for launch base support of commercial space activities. AFSPC's Director of Operations (DO) has lead signature authority for the Commercial Space Operations Support Agreement (CSOSA). The Space and Missile Systems Center (SMC) at Los Angeles AFB retains responsibility for booster production matters. As in the past, the Wing Plans office (30 SW/XPR) functions as the single point of contact for commercial space activities for the 30 SW and is responsible for coordinating initial Wing support arrangements. Once the commercial support process is begun, the support agency (30 SW) becomes the lead range responsible for coordinating with other support ranges as required to insure total program support.

The Air Force uses a variety of processes to arrange support for US commercial space operators at Air Force launch bases. AFSPC has institutionalized processes for the 30 SW to use in arranging and providing support for commercial launch operators. These processes include indoctrinating the new commercial customer, arranging use of excess capacity of Air Force launch property and services, and performing environmental impact analyses. Intermixed with these processes are the standard range documents prepared under the Universal Documentation System. Discussions of these requirements and the WR processes necessary

to support the commercial user are contained within the following paragraphs.

There are many different references that are used to arrange commercial launch support. The 30 SW has developed a Customer Handbook that describes processes for obtaining 30 SW support. This handbook is accessible through Customer Services on the 30 SW Web Site (www.vafb.af.mil).

1.1.5.1 Standard Documentation

The Universal Documentation System (UDS) specifies three levels of standard commercial user/range documentation pairs. Level 1 includes the Program Introduction and the Statement of Capability. The Level 1 documents are used to initiate program support planning. Level 2 documents, the Program Requirements Document and the Program Support Plan, may be required to provide additional or more detailed program information, especially for the more complex programs. The Operations Requirements and the Operations Directive are Level 3 documents and are used to plan for individual tests within a program. Each document is briefly described below and the flow is outlined in Figure 1-5.

1.1.5.1.1 Level 1 Documentation

Program Introduction - The Program Introduction (PI) is the initial planning document submitted by a potential customer (the range user) to the support agency (the range) immediately upon identification of the scope and duration of program activity. The potential customer should submit the PI, using best available information, enabling the support agency to initiate resource and technical planning. This information, while sometimes fragmentary and incomplete, is of substantial value to the support agency in determining the scope of the program.

Statement of Capability - The Statement of Capability (SC) is the support agency's response to the PI. When properly signed, the SC is evidence that a program has been accepted for support by the support agency (30 SW and AFSPC). Support conditions, qualifications, and resources, or other considerations, are initially identified by this document and serve as a baseline reference to subsequent acceptance and commitment by the support agency. The PI and the SC complement each other in establishing the preliminary scope of the program support activity.

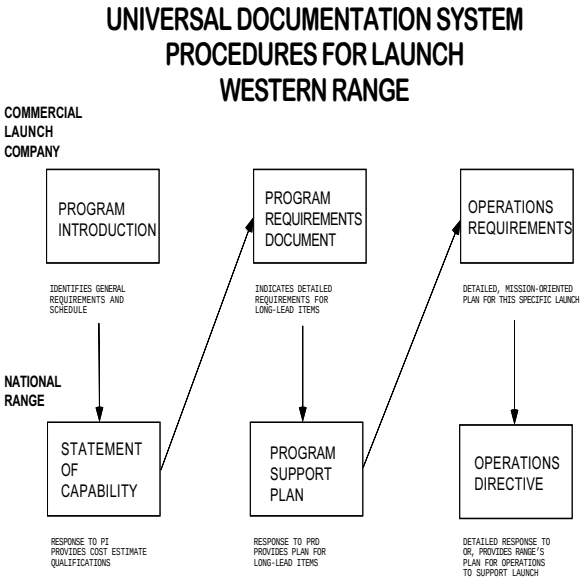


Figure 1 - 5: Standard Document Flow

1.1.5.1.2 Level 2 Documentation

Program Requirements Document - The Program Requirements Document (PRD) is a detailed full-program planning document normally required for complex or long-lead-time programs. It contains the requirements for support desired from the support agency and may contain supplemental information when needed for clarity of purpose. A PRD is submitted to assure that support capability will be available during the time period required by the commercial range user. Requirements should be submitted immediately upon identification. The user should not delay submittal of the PRD because of incomplete knowledge of support requirements. Late requirements may be accommodated, with Range approval.

Program Support Plan - The Program Support Plan (PSP) is a response to the requirements presented in the PRD and is prepared by the responsible support agency. The PSP indicates those requirements that can be met from existing resources, those that can only be met through programming new resources or through alternatives, and those that cannot be met by the support agency. The PSP is prepared on a series of forms similar to the PRD and retains the same outline and format. It is updated with revised program requirements by corresponding revision for the duration of the program. The office of primary responsibility for all PSPs is the 30 RANS/DO.

1.1.5.1.3 Level 3 Documentation

Operations Requirements - The Operations Requirements (OR) document is a mission-oriented document that describes in detail the requirements for each

mission, special test, or series of similar tests. The OR is prepared by the user. The PRD and the OR completely describes the commercial customer's mission requirements. The OR must not reflect new requirements not previously stated in the PI and/or PRD.

Operations Directive - The Operations Directive (OD) is the lead agency's response to the OR and is a detailed plan for implementation of support functions for a mission, specific test, or series of similar tests.

1.1.5.2 Establishing the New Commercial Customer

The following paragraphs explain the processes by which the new commercial customer is introduced to the procedures, documentation, and requirements that the 30 SW operates:

1.1.5.2.1 New User Introduction Process

The process by which these documents and the associated agreements meld to form a cohesive commercial program begins when the potential commercial 30 SW user makes initial contact with DoT's Associate Administrator for Commercial Space Transportation (AST) and the 30 SW Wing Plans Office (30 SW/XPR). The Wing Plans Office serves as the office of primary responsibility for new programs during the introductory phase of the test mission and will remain the single point of contact for commercial space programs. The initial Wing Planning Manager is normally selected from 30 SW/XPR and serves as the Wing Officer with Primary Responsibility (WOPR). A Wing Support Working Group (WSWG) is normally established to review and validate program requirements in the Program Introduction (PI) document. The WOPR chairs the WSWG. This group is formed to review customer requirements prior to arrival and review of the PI and work customer support requirements throughout the life of the program.

1.1.5.2.2 Initial Support Agreement

If the proposed new program is sufficiently defined, and the amount of government effort required to continue a dialogue with the prospective new user is justified, then the Wing Plans Office may recommend that the Wing Commander sign the Initial Support Agreement (ISA) with the commercial space customer. The ISA defines the terms and conditions for initial planning support and must be signed before the UDS cycle can start.

1.1.5.2.3 Initial Support Documentation

With the ISA in place detailed planning support can begin. The Wing Plans Office will work closely with the commercial space customer to produce a Program Introduction, documenting support requirements for the new program. Once the PI is completed, Wing Plans will respond with a

Statement of Capability (SC) outlining government support. The SC cannot be representing a government support commitment until it becomes part of the signed Commercial Space Operations Support Agreement (CSOSA), and the environmental impact analysis process (see para. 1.1.5.3.3) is completed.

1.1.5.2.4 Commercial Space Operations Support Agreement (CSOSA)

This Commercial Space Operations Support Agreement represents the Air Force's commitment to provide support for the commercial program, subject to satisfactory completion of the environmental impact analysis process. The commercial space customer sends a written request for AFSPC/DOSL to execute the CSOSA. AFSPC/DOSL will obtain a complete Annex from the 30 SW (signed by the Wing Commander). After coordination through the HQ AFSPC staff, AFSPC/DOSL will return a copy of the Agreement to the commercial space customer, signed by AFSPC/DO. After the commercial space customer signs the Agreement, and obtains a DoT license for launch processing, requests to obtain government support under the terms and conditions of the Agreement may begin in order to initiate launch preparations at the launch site.

The Wing executes an annex to the CSOSA which describes the Wing's support. The 30 SW document becomes Annex B.

1.1.5.3 Using Excess Capacity of Government Launch Property

This section contains the process required to initiate facility siting, the requirements for leasing or licensing Air Force real estate, and the Environmental Impact procedure that is required. Before requesting use of excess capacity, the commercial space customer must first consider commercially available launch property and services.

1.1.5.3.1 Facility Siting Process

The "Policy on Use of Air Force Real Property for Commercial Space Activities," 7 May 1996, states Air Force launch property may be provided for commercial space purposes if:

1. The property will be used to support commercial space activities;
2. Its use can be supported by existing or planned Air Force or federal resources;
3. Its use will be on a non-interference basis compatible with Air Force or federal activities;
4. Its use is consistent with public safety, national security and international treaty obligations; and,

5. Substantially equivalent property is not available from the private sector on reasonable terms:

a. Equivalent means substantially the same property in terms of function, capacity, utility, and quality.

b. Available means as and when needed by the user, to the user's reasonable satisfaction.

c. Reasonable means that price and other terms and conditions of use are commercially reasonable.

The acquisition (by lease, sale, transaction in lieu of sale) by the private sector of launch property of the United States, which is excess or not otherwise needed for public use, is to be encouraged and facilitated, including reduced charges to the private sector for such use of government property (direct costs only).

In parallel with the Environmental Impact Analysis Process, the commercial space customer should initiate the facility siting process through the Wing Plans Office. This process consists of two sub-processes, initiated by a request letter from the commercial space customer to the Wing Commander. The sub-processes consist of: (1) the explosive safety siting approval process to account for quantity-distance standoff requirements for explosive storage and launch facilities, as defined in DoD Directive 6055.9 and Air Force Manual 91-201, and (2) the community planning process, based on land use plans and constraints documented in the Base General Plan. The Base Real Estate office monitors progress and submits the results of these parallel sub-processes to the base Facilities Board and acts as the commercial space customer's advocate when the Board addresses the commercial launch operator's request.

1.1.5.3.2 Lease/License Requirements and Process

Air Force Instruction 32-9003 titled "Granting Temporary Use of Air Force Real Property" requires non-Air Force users of real estate at Air Force sites, where new facilities are to be constructed, to execute a lease for use of the real estate. Approval authority for leases exceeding five years or $100,000 rent per year rests with the Deputy Assistant Secretary of the Air Force/Installations (SAF/MII). Following SAF/MII approval, authority for negotiating, processing, executing, and administering leases is delegated to AFSPC/CE. A license is required for existing Air Force facilities that may be shared with government or other commercial space programs.

1.1.5.3.3 The Environmental Impact Analysis Process

The President's National Space Policy establishes that commercial space activities at federal launch facilities comply with the National Environmental Policy Act (Public Law 91-190, NEPA). On behalf of the commercial space

customer, the 30 SW environmental office will help the customer determine which regulatory agencies will need to be consulted. The commercial customer submits copies of all permit applications to the launch site environmental office. Even when permits for commercial activities are issued to the Air Force, the commercial space company is still legally responsible for complying with their requirements. Commercial space customers must complete the Environmental Impact Analysis Process (EIAP) before the Air Force can commit support to their programs through the CSOSA. The Initial Support Agreement (ISA) allows the Air Force to provide planning support until the EIAP is complete. "HQ AFSPC Environmental Protection Committee (EPC) Guidance on Commercial Space Activity EIAP" (October 1991) explains the process for completing the EIAP:

- Air Force Form 813 - Request for Environmental Impact Analysis: These documents form the basis for the 30 SW decision on what level of environmental documentation will be required for the proposed program (i.e., Categorical Exclusion, Environmental Assessment, or Environmental Impact Statement). This process is highlighted in the AFSPC EIAP guidance package. EIAP guidance is explained in Air Force Instruction 32-7061, "The Environmental Impact Analysis Process," dated 24 January 1995.

- Categorical Exclusion - According to the President's Council on Environmental Quality, Regulation 1508.2, "a Categorical Exclusion (CATEX) means a category of actions which individually or cumulatively do not have a significant effect on the human environment". The Air Force list of excluded categories appears as an Attachment to Air Force Instruction 32-7061. Generally, only previously-approved actions or actions with no significant environmental impact qualify for a CATEX. Examples of programs in this category include those covered by the "Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs," published by the Department of Transportation's Office of Commercial Space Transportation (DoT/OCST) in February 1986. The scope of this document is limited to privatized versions of government boosters using the same facilities and flying the same trajectories as previously-approved government programs.

- Environmental Assessment - For new programs, an Environmental Assessment (EA) may be sufficient for environmental approval if it justifies a Finding of No Significant Impact (FONSI). For commercial programs using Air Force assets, the customer must prepare the EA. The review process includes coordination among the environmental office at the launch base, (30 CES/CEV), and local, state, and federal regulatory agencies. Vandenberg's Environmental Management office has a list of organizations, their addresses and associated points of contact for more than 30 agencies that may be involved in the review process. The FONSI is executed by 30 SW once approved by AFSPC/CE. Depending on the scope of the program and the

number of regulatory agencies required to be involved, the EA/FONSI process typically requires six to twelve months.

- Environmental Impact Statement - For the new commercial customer whose activities may have significant environmental effects, an Environmental Impact Statement (EIS) and Record of Decision must be generated and approved in accordance with AFI 32-7061. The review process includes coordination within the Air Force, a series of public scoping meetings and hearings to address any controversial issues, and interface among the environmental offices at the launch site and local, state, and federal regulatory agencies. A Secretary of the Air Force decision maker will execute the Record of Decision. Depending on the scope of the program and the regulatory agencies involved, this process typically requires 12 to 36 months.

- Permits and Additional Studies - Depending on the scope of the program, in addition to the EA or EIS, reports and permits for issues like emissions and hazardous waste may be required by regulatory agencies external to the Air Force. The launch site Environmental Office, 30 CES/CEV, may assist the commercial launch operator with preparation of these documents.

1.1.5.4 Summary

The Air Force's Commercial Program has evolved to provide necessary launch head support and services that are not readily available in the commercial realm. Access to these services begins with initial contact by the commercial space customer with FAA/AST and the 30 SW Plans office. The process of establishing the new commercial customer at the launch site is a coordinated effort by several agencies to combine several processes, including the standard (UDS) documentation process, the commercial DoT license process, and 30 SW/Customer agreements, as well as operations siting, leasing/licensing, and environmental impact assessment processes.

1.2 RANGE DESCRIPTION

The Western Range is a complex of instrumentation and support facilities deployed over a designated geographical area and configured for the support of research, development, operations and test and evaluation of weapon and space systems, subsystems, and components. This includes all metric instrumentation, range safety associated equipment, telemetry, photography, meteorological, data processing, transmission, and communications equipment associated with launch operations. This specialized and general purpose equipment is used to measure, receive, record, and process data for evaluation of the performance of a system and its components or to obtain data for specific research, developmental, and operational missions. For current and more detailed information on the data herein provided, the Commercial Agency should contact the Chief, Program Requirements for the 30th Space Wing (30 SW/XPR). 30 SW/XPR is the single point of contact for all agencies wishing to avail themselves of the use of 30th Space Wing resources. Reference paragraph 1.1.5.2.1 New User Introductory Process.

1.2.1 Facilities and Instrumentation

The 30th Space Wing is located at Vandenberg AFB. Vandenberg is located in California halfway between Los Angeles and San Francisco. The 30 Range Squadron manages all Western Range resources and conducts Space, Ballistic and Aeronautical operations in the area of the Pacific Ocean.

Launches occur primarily from Vandenberg, and all mainland instrumentation is located in California. There is downrange instrumentation at both Hawaii and at Kwajalein. There are also mobile assets that can support launches on the Western Range, and other DoD and NASA resources outside of California that can be used.

1.2.2 Local and Off-Range Instrumentation

In conjunction with other ranges, principally the Naval Air Warfare Center Weapons Division, Point Mugu, and the Army Kwajalein Missile Range, the WR provides continuous and complimentary instrumentation coverage over a broad portion of the Pacific Ocean. The 30 SW instrumentation sites are located along the Pacific coast at Pillar Point AFS, Anderson Peak, VAFB, Santa Ynez Peak, and on the Hawaiian Islands.

1.2.2.1 Pillar Point

The Pillar Point Air Force Station is the northernmost instrumentation site. It is located along the California coast, south of San Francisco. It's geographical location provides an aspect angle for launch operations which diminishes challenges which could result from looking into the flame of an outbound launch vehicle. Pillar Point also provides extended coverage off the

coast of California for aeronautical tests. It is just one of the Northern California elements in the total 30th Space Wing data collection capability. At the Pillar Point facility, there are two tracking radars: the FPQ-6 and the MPS-36;a telemetry system that includes a 40 foot antenna; and the CT-4, Command Control Transmitter. Metric and telemetry data acquired by the Pillar Point facility is used for real-time decommutation and display as well as post flight processing.

The 40 foot antenna uses an elevation over azimuth pedestal. The system is capable of automatically tracking any inter-Range Instrumentation Group, telemetry modulation in the L-band and upper and lower S-band frequencies. This telemetry antenna provides a valuable "side-look" during Vandenberg launches.

The FPQ-6 C-band Radar is a high accuracy, long range, amplitude comparison monopulse tracking system that can operate in both skin and beacon modes. It is of the Missile Precision Instrumentation Radar class and has undergone various upgrades to the antenna drive system, console, receiver, transmitter, and RF feed sections. The antenna is a 20 foot parabolic Cassegranian reflector supported by an elevation over azimuth pedestal.

The radar subsystems provide the data handling interface with time, range, azimuth, elevation, doppler frequency, and radar status information. The radar embedded computer system formats data for on-site recording, display, and off-site transmission.

The MPS-36 is a C-band monopulse tracking radar. It is considered a mobile radar and is contained in three trailers plus an antenna lowboy. The antenna is a 12 foot parabolic Cassegranian reflector.

The MPS-36 has an Integrated Circuit Digital Range system which assists in the acquisition of skin and beacon targets. Target range, azimuth, elevation data, and time are output to a console for display, and recorded for post operation data production.

CT-4 is an operational command control transmitter site located at Pillar Point to provide additional command control flexibility for operations. CT-4 is used to support both Vandenberg and naval operations and can be controlled from both Vandenberg and Point Mugu. The directional antenna is a 15 foot parabolic dish antenna.

1.2.2.2 Anderson Peak

The Anderson Peak optical tracking site is situated at an elevation of 4,020 feet on the central coast of California. Because of its altitude, Anderson Peak is approximately 1,000 feet above the marine convection layer. This puts it above a high percentage of atmospheric turbulence and its position provides an excellent side view aspect angle for certain launches and aircraft flight tests in the off-shore corridor.

The Deployment Mapping Instrument, located at Anderson Peak, is a high quality, Ritchey-Chretien modified Cassegranian telescope having a 36 inch diameter primary mirror, and a 288 inch basic focal length. The instrument is equipped with a variety of sensor systems to aid acquisition, such as a low light level sensor system and a high speed shuttered telescope/camera system. All video data can be recorded. Video annotation and metric data are included with all data products.

1.2.2.3 Vandenberg Air Force Base

Vandenberg Air Force Base (VAFB) is the launch head for the space and ballistic missile launches on the Western Range. The base is divided into two parts, North Base and South Base, by a public road that lies between the city of Lompoc and the Pacific Ocean.

Most ballistic missile launch activity is on North Base and most spacelift activity is on South Base. Most of the personnel facilities are located on North Base, as in the runway. Commercial programs are using both North and South Base for their spacelift activities.

The High Accuracy Instrumentation Radar (HAIR) is a long range, high accuracy, C-band monopulse tracking system which provides support to Vandenberg launches. It is a one of a kind radar and has undergone extensive upgrades to the antenna drive system, console, receiver, transmitter, and RF feed sections. HAIR is located on a site that provides good coverage of most launches. A main building houses the radar equipment, administrative and support areas. The antenna is a 29 foot parabolic Cassegranian reflector and is located just outside the main building. The antenna is supported by an elevation over azimuth pedestal.

The TPQ-39 Radar System is a mobile X-band monopulse tracking radar. The TPQ-39 consists of an electronic equipment and antenna subsystem trailer. The MPS-39 was originally called the Early Acquisition Radar, but TPQ-39 is now the preferred designation. In general, X-band radars can provide improved precision, discrimination, and accuracy, but they operate

over shorter ranges. They also have some advantages in operating at low elevation angles.

CT sites 1, 2, and 3 are located at Vandenberg. CT-4 is located at Pillar Point Air Force Station, and CT-6 is located at Point Mugu. All five Command Control Transmitter sites are capable of being controlled from Vandenberg. CT sites 4 and 6 are capable of supporting Naval operations and can be controlled from Point Mugu. These sites provide a command control capability including early flight termination of launches, if necessary. A dual redundant system ensures the transmission of flight termination commands.

The Air Route Surveillance Radar (ARSR) is located on South Base. It is approximately two miles inland from the Pacific Ocean, at an altitude of approximately 1500 feet, overlooking all of Vandenberg and surrounding areas. The ARSR was developed and manufactured to meet requirements specified by the Federal Aviation Administration, the FAA. The system was designed for long range surveillance of commercial air routes under the control of the FAA. The ARSR is a pulse type radar and produces a map-like display of the locations of aircraft within a 200 Nautical Mile radius of the Radar's antenna. This data is presented on a Plan Position Indicator, at the master console located at the surveillance site, and is also transmitted to Vandenberg for input into the Area Control Center Display System.

The TPQ-18 C-band Radar is a high accuracy, long range monopulse tracking system that can operate in both skin and beacon modes. It has undergone various upgrades to the antenna drive system, console, receiver, transmitter, and RF feed sections. It was originally designed as a transportable radar, but is now a fixed installation on South Vandenberg. The antenna is a 29 foot parabolic Cassegranian reflector and is supported by an elevation over azimuth pedestal. The radar subsystems provide the data handling interface with time, range, azimuth, elevation, doppler frequency, and radar status information. The radar embedded computer system formats data for on-site recording, display, and off-site transmission.

A facility the size and complexity of the Western Range requires some mobile systems to augment the fixed site systems. Since Range testing requirements are not predictable, it is necessary to be able to reconfigure the Range for unique tests when required. Mobile instrumentation is a way to provide this type of flexibility. Some of WR's mobile resources include the following systems.

For telemetry, the Mobile Telemetry Receiving Station (MTRS), is comprised of a motorized van with an L- or S-band tracking antenna pedestal mounted on a towed trailer, with telemetry receiving equipment and communications

subsystems. This equipment is used to receive and relay telemetry data transmitted by a variety of vehicles. The MTRS uses an 8 foot autotrack antenna with a Global Positioning System. MTRS can receive, record and relay 4 links simultaneously.

Mobile optical systems include the Contraves Kineto Tracking Mount (KTM), and the Mobile Skyscreen. The KTM, is a versatile, mobile and precision tracking system used extensively on today's modern test ranges. Featuring high mobility, modular design, and optional remote control, the KTM can be configured and expanded for a multitude of tracking applications. This includes up to 600 pounds of optical instruments for data collection. No single instrument can exceed 300 pounds. The Mobile Skyscreen is essentially a mobile television van. The Skyscreen is placed to view the launch, either looking down the planned flight path (back azimuth view) or a view normal to the flight path (program view) of the missile. The back azimuth view indicates if the missile is rising off the launch pad and following the planned trajectory. The program view indicates if the missile is programming over and heading downrange, following the planned trajectory.

The Western Range utilizes five identical-looking 27 foot Range Safety Support Vans to supplement Range instrumentation. While each van performs one of four different functions, each also provides a valuable service to the 30th Space Wing. The vans are equipped for field deployment and are completely self-contained, having motor generators to supply technical power, air conditioning, and heating. They are individually described as follows:

The Radio Frequency (RF) Measurements Van is designed and equipped to perform the following functions:

- Spectrum Surveillance,
- Signal Analysis,
- Frequency Measurements and Monitoring, and
- Stripchart and Magnetic Tape Recording.

The Transponder Test Van #1 (TTV-1) and the Transponder Test Van #2 (TTV-2) are operated and maintained by the RF Measurements Laboratory (RFML). These vans are used for field testing and troubleshooting of Range user transponders. Such tests ensure that transponders are in compliance with Range standards before being released for operational uses.

The Command Receiver Test Van (CRTV) is available for field tests on Range user command receivers and command receiver test sets. Performance characteristics of the command receivers are displayed and evaluated within the CRTV itself. If command receiver test

stations are provided by the Range user, RFML personnel verify that these test stations operate within the limits and specifications acceptable to Range Safety. This van is designed to operate at the Range user facility or other designated areas.

The Range Safety Test Van (RSTV) serves as a mobile shelter for command receiver and super high frequency (SHF) transponder testing at remote locations on Vandenberg and at off-base locations. The RSTV supports bench level testing as well as preflight testing.

1.2.2.4 Tranquillon Peak

Tranquillon Peak is a 2,126 foot tall peak on South Vandenberg. It provides an ideal vantage point overlooking all of Vandenberg Air Force Base, usually from above the marine convection layer. Three primary instruments are located on Tranquillon Peak: the Multiple Object Tracking Radar, the FPS-16 Radar and the LA-24 Tracking Telescope.

The MPS-39 C-band Multiple Object Tracking Radar, called the MOTR, is a transportable, phased array, instrumentation tracking radar. It has an electronically steerable beam to simultaneously track up to forty objects in beacon and skin modes, and can provide multiple scans for target acquisition. This instrument supports space launches from Vandenberg, spacetrack, aeronautical, and Space Shuttle missions. The MOTR was originally mobile, but is now installed in a building on Tranquillon Peak on South Vandenberg. It is especially suited to tracking major components in anomalous launches. For example, if a booster should explode during powered flight, the MOTR might track the major components to impact as an aid to recovery operations. It is also used in premature separation where more than one stage still may be powered.

The FPS-16 Radar is a C-band monopulse tracking system, with operation in both skin and beacon modes. The primary function of this radar is to provide data for Vandenberg missile launches and air vehicles in the off-shore flight corridor. The FPS-16 is housed in a building on South Vandenberg at Tranquillon Peak, with the pedestal and antenna subsystem on the roof. The radar system provides range, azimuth, elevation, and metric calibration data. The data system adds IRIG “B” timing to the data. The computer reformats the data for on-site recording and for off-site transmission.

The Large Aperture Tracking Telescope, called the LA-24, is located on Tranquillon Peak, with a commanding view of Vandenberg’s launch complexes. A Newtonian telescope, the LA-24 consists of a 24 inch aperture primary mirror with a motorized zoom lens system. This provides high quality, stop action video, which is useful during vehicle analysis. A quick

change mount enables rapid sensor changes to be made during operational support. A video annotation system is utilized to annotate the data products with azimuth and elevation angles, focus data, camera shutter speed, field of view, operation number, IRIG timing, countdown clock, and other relevant information with respect to operational support.

1.2.2.5 Vandenberg Telemetry Receiving Site

The Vandenberg Telemetry Receiving Site (VTRS) is located south of Lompoc, California. VTRS was equipped and activated between 1970 and 1971. It is primary mission is to track targets transmitting telemetry signals, and to record and relay received signals. VTRS acquires data from launches of ballistic missiles, space launch vehicles, and aircraft test flights. Telemetry data are transmitted to the Telemetry Analog Equipment Room for distribution, data processing, and display. VTRS is designed to meet the IRIG telemetry and recording standards. Its various antenna systems are outlined below.

The GKR-7 is a 30 foot parabolic antenna that provides automatic tracking of specially equipped airborne vehicles. The GKR-7 tracks incoming signals and records and displays digital and analog angle data. The system uses variable scan monopulse radio frequency tracking electronics. Azimuth and elevation angles, antenna modes and servo errors are recorded.

The 10 meter Autotrack Antenna System is also called the ATTAS antenna. It is an elevation over azimuth type of antenna, using a 10 meter parabolic reflector, with a variable scan single-channel monopulse tracking system. The antenna is capable of operating in autotrack, slave, manual, or command modes, and it can also be computer driven. Azimuth and elevation angles, antenna modes and servo errors are recorded.

The Canoga Antenna is an 8 foot parabolic reflector installed on a pedestal, similar to the Quad Helix antennas. The broader beamwidth of this antenna is useful for target acquisition, with hand-off to a narrow beam high gain antenna after acquisition.

There are two Quad Helix antennas used to provide support on the VTRS. The antennas can be operated in the manual or slave modes only. In the manual mode, the antennas are positioned by the azimuth and elevation handwheels. These antennas are presently capable of operating in two major modes: satellite relay operations or UHF communications. In the satellite relay mode, Quad Helix #1 may be configured to transmit (uplink) or receive (downlink). Quad Helix #2

will operate in the receive (downlink) mode only, while in this configuration.

1.2.2.6 Santa Ynez Peak

Santa Ynez Peak is located approximately 30 miles east of the Vandenberg launch complexes, at an elevation of 4,133 feet. It is approximately 1000 feet above the marine convection layer. It is located above a high percentage of the atmospheric turbulence, and its position provides an excellent broadside aspect angle for polar launches or for aircraft flight tests in the off-shore corridor.

Located on the Peak is the Recording Optical Tracking Instrument. Its main tube optics consist of a 24 inch diameter primary mirror Newtonian telescope, with a basic focal length of 100 inches. The system employs a motorized zoom lens system similar to the LA-24. A quick change mount enables rapid sensor changes to be made during operational support. A video annotation system, also similar to that used on the LA-24, is utilized to annotate the data products.

1.2.3 Meteorological Support

The Vandenberg Base Weather Station (BWS) serves as the hub of weather data acquisition and processing systems supporting operations on Vandenberg Air Force Base. The center operates 24 hours every day to meet the collective needs for monitoring meteorological conditions which may inhibit or be hazardous to operations.

The systems that collect data include the following: Weather Information Network Display System (WINDS), Doppler Acoustic Sounding System (DASS), Meteorological Sounding System (MSS), Lightning Location and Protection System (LLPS), Geostationary Operational Environmental Satellite (GOES), Wind Profiler and Radio-Acoustic Sounding System (RASS), and the Automated Surface Observing System (ASOS).

The weather tower system is the Weather Information Network Display System (WINDS). The towers are located near fuel storage, tracking, and launch facilities to enable monitoring of operational constraints and safety hazard criteria for the sites. Data from the entire network is digitized from each remote site for transmission to the Base Weather Station for processing, quality control, display, and archiving. Data recorded is forwarded to the Air Force Environmental Technical Application Center (ETAC) for use in engineering studies and climatological analyses required to support range users. Meteorological data for the entire range is processed each minute.

The Doppler Acoustic Sounding System (DASS) wind profile measuring system can monitor wind movement to 500 meters above ground level. The DASS enables continuous measurements of the average and standard deviations of the three wind components, and direction and speed for ten altitude intervals between 50 and 500 meters above the ground.

The Meteorological Sounding System (MSS) tracks two types of expendable balloons carrying transponders: the Rawinsonde and Windsonde. The system provides range, azimuth and elevation data from the Windsonde transponder. It receives, processes and transmits the data to a Real-Time Rawinsonde/Wind Processing System (RTR/WPS), which is located within the BWS. The resulting trajectories are used to calculate the direction and speed for clouds of heated toxic effluents from the engines of launch vehicles.

The Lightning Location and Protection System (LLPS) consists of the following subsystems: four Advanced Lightning Direction Finders (ALDF), an Advanced Position Analyzer (APA), an APA system terminal, a local display with color inkjet printer, and a remote display. The ALDF automatically detects more than 90 percent of all cloud-to-ground lightning occurring within their nominal range of 100 nautical miles. When a flash is detected, the ALDF measures the bearing angle to the ground strike point. It then transmits the angle, number of return strokes, signal strength, and flash duration to the APA. The APA, located in the BWS, collects the flash data from the ALDF and calculates strike locations.

There are two systems used in the collection of the Geostationary Operational Environmental Satellite (GOES) weather data: the Weather Image Recorder and the Meteorological Interactive Data Display System.

> The Weather Image Recorder is an ALDEN Model 9893. This photo recorder, called a Visorfax, is a stand-alone recorder designed to receive satellite imagery from various sources of GOES data. It provides unsurpassed photographic-quality, continuous-tone, image hard copy by the use of a unique combination of advanced digital computer technology and laser optics, on either paper or film, which requires no subsequent chemical processing.
>
> The Meteorological Interactive Data Display System (MIDDS) provides the capability to build a data base by modifying and blending conventional data in a visual format, which is then used in the preparation of forecasts and products to support the Vandenberg mission. The MIDDS also assimilates real-time geostationary weather satellite data and conventional weather data.

The Wind Profiler is a clear-air Doppler Radar that measures the horizontal winds above the radar. It consists of the Profiler Radar at a remote site and a local computer system. The Wind Profiler operates in conjunction with the Radio-Acoustic Sounding System, or RASS, which measures temperature profiles in the lower troposphere. RASS emits an acoustic signal whose propagation velocity is measured by the wind profiling radar. The speed of sound, measured at each level, is converted to a temperature. The accuracy is better than 1°C. The sounding system must operate at a distance from human habitation, since many people within earshot of the acoustic transmitter find the noise irritating.

The Automated Surface Observing System (ASOS) is an automated surface weather observing system reporting temperature, pressure, wind speed and direction, visibility, and present weather. In addition, ASOS provides continuous atmospheric information. It reports basic weather elements, such as sky conditions, which include cloud height and amount (clear, scattered, broken, or overcast) up to 12,000 feet and visibility (to at least 10 statute miles). It also reports basic present weather information, which includes type and intensity for rain, snow, and freezing rain; obstructions to vision, such as fog and haze; and pressure, which includes sea-level pressure altimeter settings. Other information reported by ASOS includes ambient temperature, dew point temperature, wind direction, speed, character (such as gusts and squalls), and precipitation accumulation. Selected significant remarks include variable cloud height, variable visibility, precipitation beginning and ending times, rapid pressure changes, pressure change tendency, wind shift, and peak wind.

1.2.4 Naval Air Warfare Center Weapons Division , Point Mugu, CA

The Naval Air Warfare Center Weapons Division is located at Point Mugu on the California coast South of VAFB between Santa Barbara and Los Angeles. This Center is responsible for the Sea Test Range and is also a Major Range and Test Facility Base in its own right. The Navy tests air to air, air to surface, surface to air, and surface to surface weapons on the Sea Test Range.

Although Point Mugu is heavily instrumented to support operations on the Sea Test Range, it is also configured to support launches from Vandenberg as well. These instrumentation systems include the Command Transmitter site on Laguna Peak, the FPS-16 radars and telemetry antennas on the main base, and the FPS-16 radars and telemetry antennas on San Nicolas Island.

Laguna Peak is located next to Point Mugu, at an elevation of 1,500 feet. It is the site of some of Point Mugu's instrumentation, including surveillance. It includes a large antenna to support the Navy's Transmit Satellite Program. It also serves as a site for the CT-6. Its location, south of Vandenberg and

east of nominal orbit trajectories, provides a good look angle for polar launches, and covers the southern end of the West Coast Offshore Operating Area. CT-6 utilizes data and voice communications between the site and Vandenberg.

There are three FPS-16 radars on the beach at Point Mugu, and three FPS-16 radars on San Nicolas Island (SNI), all of which can be used to support Vandenberg operations. These radars are similar to the Vandenberg FPS-16 on Tranquillon Peak.

San Nicolas Island is about 65 miles West-Southwest of Point Mugu. It is a large island that includes a runway for landing supply aircraft and full scale aerial targets. It is instrumented with telemetry and radar systems to support testing in both the Inner Sea Test Range between Point Mugu and SNI and the Outer Sea Test Range beyond SNI. One of the Island radars is specifically configured to support launches from Vandenberg. SNI is connected to Vandenberg by microwave links.

1.2.6 Hawaiian Islands

The Hawaiian Islands are located in the midrange area for ballistic missile tests, between Vandenberg launch head and the Kwajalein terminal areas. Support facilities for the Western Range are located on Oahu, Molokai, and Kauai Islands.

Oahu is the most populated island in the Hawaiian Islands. There are three significant sites on Oahu that belong to the Western Range: Wheeler, Kaena Point Radar Facility, and Ewa Beach.

Wheeler Switch is located on Wheeler Army Airfield, just northwest of Honolulu. It is a communications hub for the Pacific Area and serves to route data from the Pacific Area back to Vandenberg. It provides connectivity to remote systems, to Vandenberg, to other Department of Defense agencies and to NASA.

Kaena Point is located on the northwestern shore of Oahu. It is the location for the FPQ-14 radar. The FPQ-14 Radar System is a high accuracy, long range, monopulse tracking system incorporating both skin and beacon modes. It provides the 30th Space Wing with accurate trajectory data in support of weapons system testing. A main building houses the radar equipment, administration and support areas. The radar's antenna is located just outside of the main building.

Ewa Beach is located northwest of Honolulu, on the island of Oahu. It is the transmitter site for high frequency communications from Hawaii

back to the mainland and serves as a backup to other forms of communication. This site was chosen because it is in a relatively uninhabited part of the island where the operation of high power transmitter produces minimal interference.

Molokai is another of the Hawaiian islands located southeast of Oahu. It is relatively undeveloped and serves as a site for a high frequency receiver for radio communications to the Hawaiian area of the Western Range.

The island of Kauai is located northwest of Oahu. The primary item of interest to the Western Range on Kauai is the Pacific Missile Range Facility (PMRF). The PMRF, is one of the few Ranges that supports both test and evaluation and training. PMRF includes a large instrumented Range that can support aeronautical, space, ballistic missile, surface and even subsurface participants. This Range is important because the radar and telemetry systems can also support Western Range operations.

1.2.7 Kwajalein Missile Range

The United States Army operates the Kwajalein Missile Range, called KMR. The Army group that manages the Range is called USAKA, for United States Army, Kwajalein Atoll. USAKA is a portion of the Space and Missile Defense Command at Huntsville, Alabama. The KMR is a Major Range and Test Facility Base covering the Kwajalein Atoll and surrounding areas.

The Kwajalein Atoll is about 4,000 nautical miles south, southwest from Vandenberg, in a line with the Hawaiian Islands. The Atoll is only about 600 nautical miles above the equator, almost due-north from New Zealand. There are approximately 100 small islands on the reef, with a total land area of only 14.5 square miles. None of the islands is more than 15 feet above the surface of the water in the lagoon. The three largest islands are Kwajalein, Roi-Namur, and Ebadon. The Atoll forms a crude crescent with the concavity facing southwest. Its longest dimension (Ebadon to Kwajalein) is 65 nautical miles and the average width of the enclosed lagoon is about 13 nautical miles. Water depth in the lagoon averages only 100 to 180 feet, and with a surface area of 2,850 square miles, it is the worlds largest lagoon.

Kwajalein Island is the southernmost island of the Kwajalein Atoll. It is also the Headquarters for USAKA. It has 3.1 square miles of surface area, and a full runway frequented by Air Micronesia and other commercial carriers. Facilities supporting Western Range missions include FPQ-19 band metric tracking radar, two MPS-36 C-band radars, a complete weather center and a Command Transmitter.

The FPQ-19, located on Kwajalein Island, is similar to the FPQ-6 at Pillar Point. It is a C-band monopulse radar, that is capable of manual or automatic radio frequency or optical tracking. It was originally designated TPQ-18 in its mobile configuration and was one identical to the TPQ-18 at Vandenberg. The radar has undergone various upgrades to the antenna drive system, console, receiver, transmitter, and microwave sections. The antenna is a 29 foot parabolic Cassegranian reflector. The antenna is supported by an elevation over azimuth pedestal. Its subsystems provide the data handling interface with time, range, azimuth, elevation, Doppler frequency, and radar status information. Time is synchronized to a cesium beam frequency standard. The radar embedded computer system formats this data for recording, display, and transmission.

Roi-Namur is located at the northernmost point of the Kwajalein Atoll, about 80 kilometers from Kwajalein Island on the eastern edge of the reef. This is the location of the Lincoln Laboratories Kiernan Reentry Measurement Site, called the KREMS. The site was established to study reentry phenomenology in support of ballistic missile defense programs. Launches from Vandenberg provide near ideal Targets of Opportunity for these studies. KREMS includes a number of sophisticated radars. These include the ARPA Lincoln C-band Observable Radar (ALCOR), the ARPA Long-range Tracking and Instrumentation Radar (ALTAIR), the Target Resolution and Discrimination Experiment (TRADEX), and the Millimeter Wave (MMW) radar.

TRADEX was the original, primary sensor for the KREMS and has been operational since 1963. It served as a UHF tracker and L-band illuminator. It was subsequently upgraded to operate at VHF, UHF, and L-band frequencies and recently upgraded again to support only coherent operation in the L- and S-bands.

The ALTAIR radar was developed to gather coherent data on reentry vehicles and satellites. Operating at the lower frequencies provides a wide dynamic range, good range resolution, multiple target tracking, and high pulse repetition frequency. ALTAIR has a massive 45.7 meter diameter antenna that rotates in azimuth on railroad wheels. It employs a Cassegraninian feed and frequency selective subreflector to provide monopulse tracking at either frequency. This sensor plays a role in foreign launch detection.

ALCOR is a high power, narrow beam, coherent, chirped, C-band, monopulse tracking radar. It can operate independently or in unison with other KREMS sensors. ALCOR is primarily a metric tracking radar, but it also supports weather measurements.

The Millimeter Wave Radar, called the MMW, is a dual frequency monopulse tracking radar operating at KA- and W-bands. It is characterized by high range and Doppler resolution, high sensitivity, precision pointing and tracking, waveform flexibility and significant signal processing capability. It can function either as an independent target tracker or through the KREMS sensor network.

Roi-Namur also has some optical and telemetry systems of interest to the Western Range. These include: a Recording Automatic Digital Optical Tracker (RADOT), a Super RADOT, a ballistic camera, a fixed camera tower, a spectral ballistic camera, a closed circuit television, and 3.3 and 45.5 meter telemetry antennas.

Ennylabegan is on the western side of the reef near Kwajalein Island. It serves as the primary telemetry data collection point for the Kwajalein Missile Range. Functions include the reception, recording, decommuntation and display of telemetry data. Ennylabegan offers one 9 meter S-band auto-slave tracking antenna, one 7 meter S-band auto-slave tracking antenna, Four 3 meter S-band auto-slave tracking antennas and one L-band slave-only tracking antenna. The site also includes timing, communications, and test equipment.

Meck Island is on the eastern side of the reef about one third of the distance from Kwajalein to Roi-Namur. It is the primary launch site for vehicles launched from the Kwajalein Missile Range. The primary instrumentation on Meck Island is a set of three fixed camera towers.
Additional specifications for the Kwajalien Missile Range can be obtained from FAA/AST's document "United States Army Kwajalein Atoll/Kwajalein Missile Range, Launch Site Safety Assessment" June 1999.

1.3 WR COMMERCIAL VEHICLE SUPPORT CAPABILITY

Vehicles launched from the Western Range are restricted to certain launch azimuths because of the risks associated with overflight of populated land masses and launch vehicle hazards that could endanger the public following a catastrophic event. Specifically, public risk criteria, as shown in EWR 127-1, may not exceed a mission casualty expectancy of $E_c = 30x10^{-6}$. In addition, the flight trajectory must be designed to accommodate Range Safety's capability to control launch-related risks. A sufficient safety margin must be provided between the intended flight path and protected areas so that a normal vehicle will not violate destruct limits. Also, the launch profile must not be so steep during the initial launch phase such that critical coastal areas cannot be protected by standard safety destruct limits.

How close to the continental US or any populated land mass a vehicle may fly is affected by its flight profile, turning capacity, and explosive characteristics due to destruct action, impact, or catastrophic events. This can vary significantly by types of vehicles and among flights of the same vehicle, depending on payload and other vehicle configuration differences. The distance between destruct lines and the area they are to protect is entirely vehicle and mission-specific. There is no required minimum distance from land for impact limit lines.

The overflight of any inhabited land mass is discouraged, but may be approved by the 30 SW Commander given sufficient justification and a satisfactory risk analysis. Launches, that overfly South America, have been approved for flights with ground traces which cross the continent below 40^{o} South Latitude, with dwell time on the order of 2-3 seconds, and for which a risk analysis has shown that the casualty expectancy satisfies established criteria ($30x10^{-6}$ collectively and $1x10^{-6}$ for an individual). Figure 1-35 shows an artistic representation of such a mission.

The identification of operation-related hazards and the assessment and quantification of risk is used to determine the operational constraints. The hazards associated with each source of risk (debris impact, toxic chemical dispersion, and acoustic overpressure) has associated with it a set of critical parameters and thresholds of acceptability. Changes in launch parameters (e.g. azimuth, payload, and launch site) and the need for flight safety controls (e.g. evacuation of personnel, enforcement of roadblocks, and restriction of sea lanes or airspace) will depend on the results of the hazard assessments.

Trajectory limits are dependent upon the associated risks to the "public domain" and the mission objectives. Launches with potential azimuths

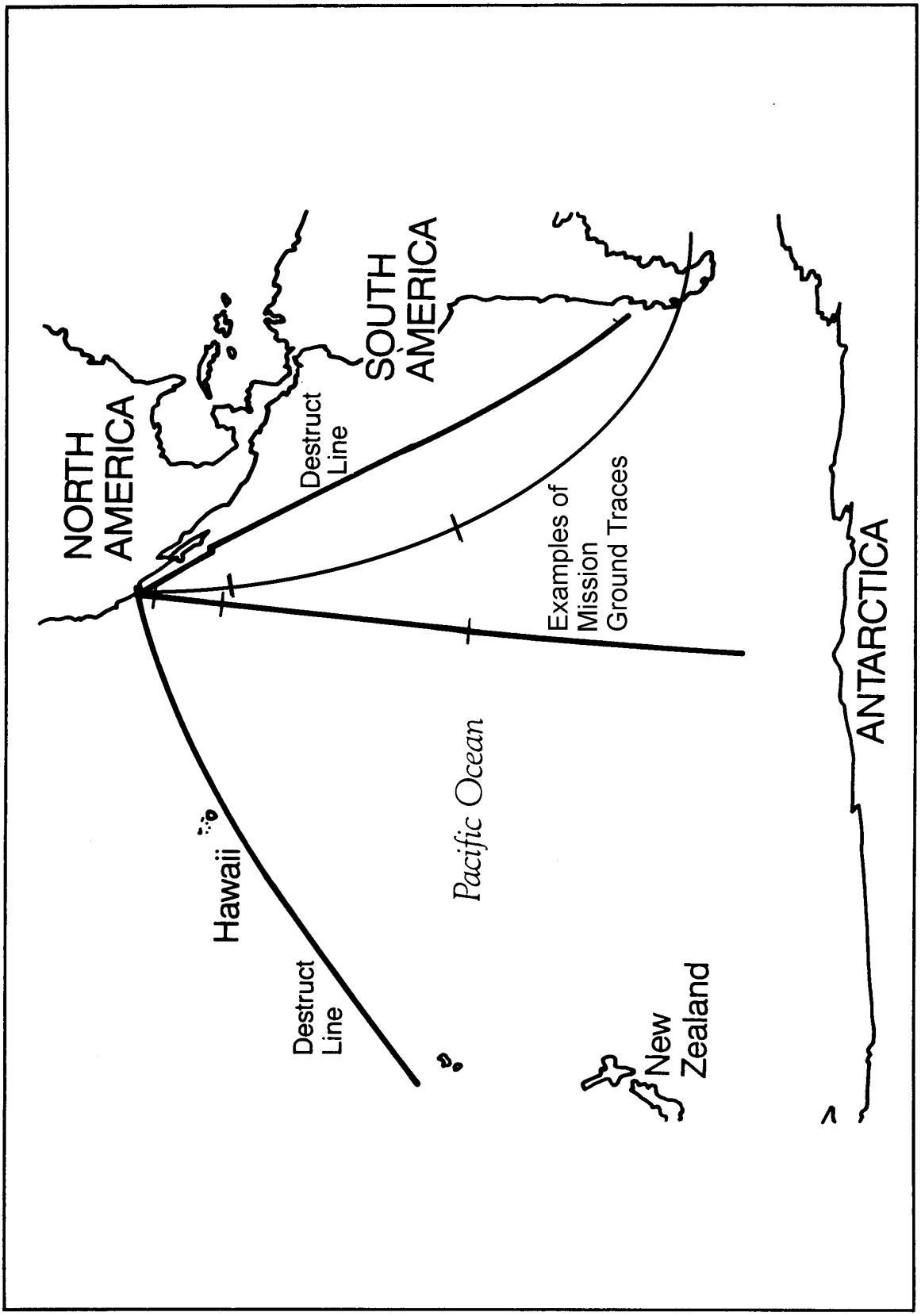


Figure 1 - 6: South American Overflight

between 155 degrees clockwise to 315 degrees, with impact ranges less than approximately 3500-miles, are normally considered to be within the allowable limits. Military launches proposed outside these limits have been permitted, based on high priority justifications and risk assessments. At the present time, there are no limits on the physical size of launch vehicles that can be supported at the Western Range.